Design and Optimization of Gas Sensor Testing Chamber Using COMSOL Multiphysics®

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Abstract

Gas sensors are the most researched and highly commercialized products in the MEMS portfolio. Various gas sensors have been used in different fields from household requirements to highly toxic environments. Metal Oxide based gas sensors are the highly promising devices which exhibit high sensitivity and selectivity characteristics. Designing a testing chamber for analyzing and studying the behavioral and performance characteristics of developed gas sensor is very vital.

Achieving a highly reliable and optimized gas chamber design cannot be done without using a modeling, analysis and optimization tool like COMSOL Multiphysics®. This paper involves interaction between various phenomena such as gas flow, thermal conduction, chemical reaction etc. to go hand in hand to study a gas sensing characteristic of a sensor. It is also necessary to design a gas sensing chamber which should accommodate testing of the developed gas sensor for sensitivity and selectivity.

This paper aims at the design and optimization of such a Gas Sensing Chamber. The design takes advantage of the multiphysics simulation capabilities of COMSOLMultiphysics® to incorporate various physics such as CFD, Micro fluidics, Solid Mechanics, Electro-thermal effects etc. The optimization needs to be done at multiple levels such as mixture of two gases, arriving laminar flow over the substrate, thermal conduction of required heat from the heater to the substrate etc. The design needs to be optimized in terms of position of vents, placement of sensor, dimensions of heater, metal oxide coated substrate etc.

Mixing of two inlet gases have been achieved by baffles. The position, angle and gap between the baffles have been optimized to give a good mixture of inlet gases. Positioning of the substrate from the baffles, angle of placement of substrate to the gas mixture flow have been optimized to achieve a good turbulent to laminar transition, enabling a smooth laminar flow over the substrate. Gas sensing characteristics are under study now.

Reference

1) Mr. Satyaprakash Narayan Das and Dr. Gouranga Bose211Centurion Institute of Technology, Centurion University and Research, “Study of Fluid Dynamics and Heat Transfer in MEMS Structure”, COMSOL Conference 2012, Bangalore
2) Nagi Elabbasi, Xiaohu Liu, Stuart Brown (Vervst Engineering) Mike Vidal, Matthew Pappalardo (Nardson EFD) “Modelling of Laminar Flow Static Mixers”, COMSOL Conference 2012, Boston, MA.

Figures used in the abstract

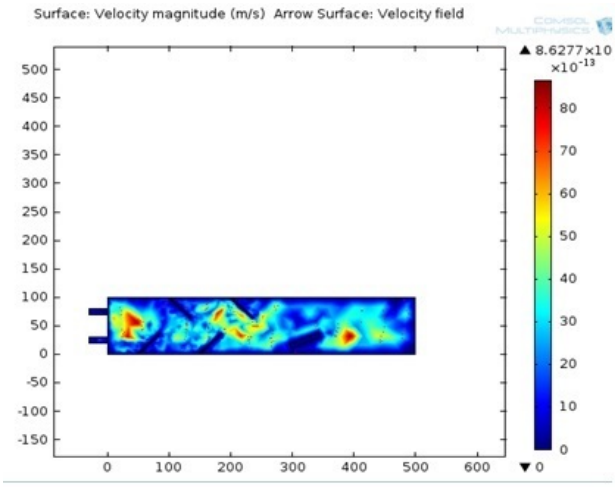

Figure 1: Gas Mixture Baffle Optimized Design

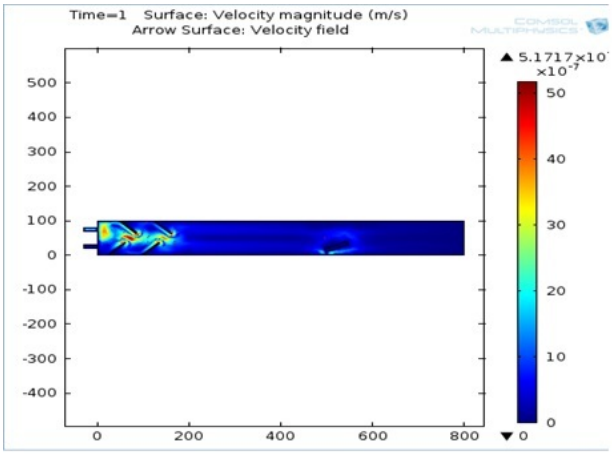

Figure 2: Gas mixture with different velocity of inlet gases